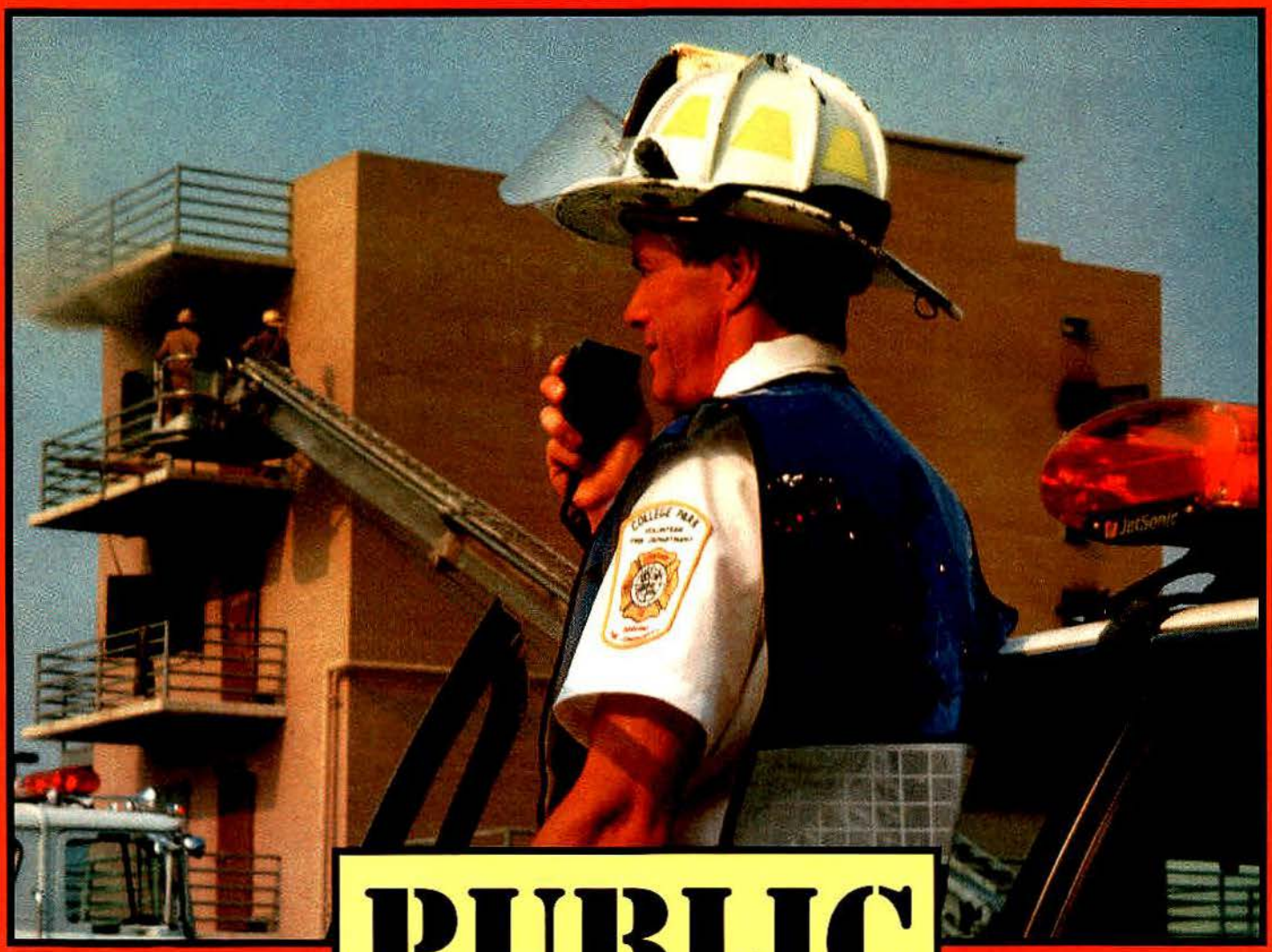
Mobile Radio Technology

The journal of mobile communications technology



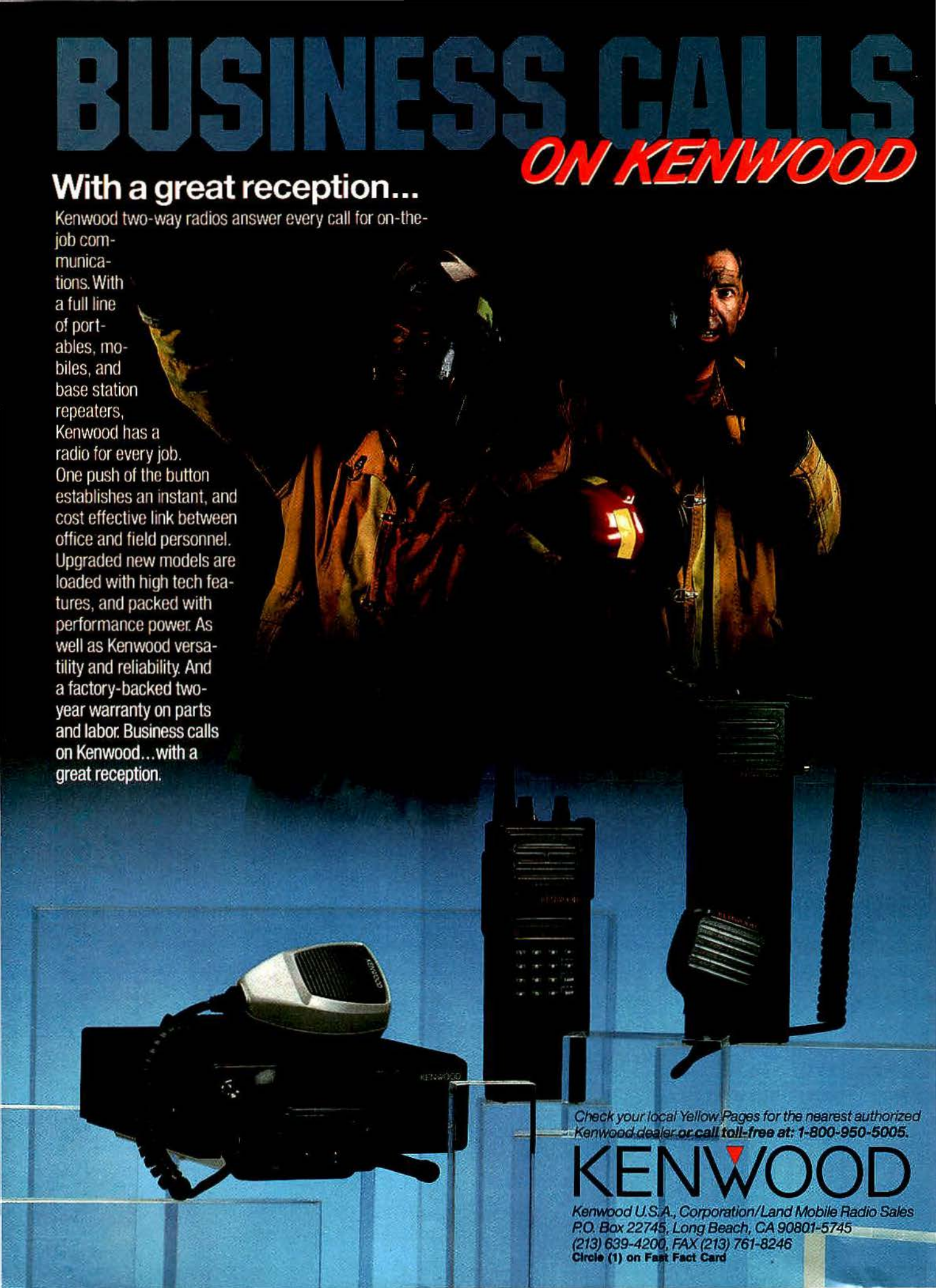
PUBLIC SAFETY

AN INTERTEC PUBLICATION • SUPPLEMENT TO MOBILE RADIO TECHNOLOGY

BUSINESS CALLS ON KENWOOD

With a great reception...

Kenwood two-way radios answer every call for on-the-job communications. With a full line of portables, mobiles, and base station repeaters, Kenwood has a radio for every job. One push of the button establishes an instant, and cost effective link between office and field personnel. Upgraded new models are loaded with high tech features, and packed with performance power. As well as Kenwood versatility and reliability. And a factory-backed two-year warranty on parts and labor. Business calls on Kenwood...with a great reception.



Check your local Yellow Pages for the nearest authorized Kenwood dealer ***or call toll-free at: 1-800-950-5005.***

KENWOOD

Kenwood U.S.A., Corporation/Land Mobile Radio Sales
P.O. Box 22745, Long Beach, CA 90801-5745
(213) 639-4200, FAX (213) 761-8246
Circle (1) on Fast Fact Card

MAGNUM – XR
WILL MAKE YOUR DAY!

MEET MAGNUM – XR
The REAL Dual Band/Cross-Band Mobile Radio System

A single control unit can provide:

- Dual Band, VHF/UHF Operation
- Light Bar and Siren Control
- Built-in Public Address
- 3 Programmable RF Power Levels
- In-Band/Cross-Band Repeat
- In-Band/Cross-Band Priority Scanning
- 1024 Channels
- Optical Fiber Control Cable
- Portable Repeat
- 96 Programmable Priority Channels
- Built-in Alphanumeric Autodiagnostics
- Multi-Area Operation
- Inter-Agency Communication
- Customized Keypad Mapping
- Programmable Alphanumeric Display

AND MUCH MORE . . . **MAGNUM IS LOADED!**

MAGNUM – XR COMPUTERIZED DUAL BAND RADIO SYSTEM

MAGNUM IS DATA READY and its unique patented all push-button super compact control unit and serial digital interface provide operator access to virtually limitless system configurations in one compact panel. **MAGNUM** readily adapts to existing systems and immediately adds new capabilities.

For more information on how **MAGNUM** can add **POWERFUL** capabilities for you, or a no obligation demonstration, **contact Teletec Corporation, P.O. Box 20405, Raleigh, North Carolina, 27619, Phone (919) 556-7800, Fax (919) 556-6180.**

*See a live demonstration of the **MAGNUM – XR** in Booth 718 at the National APCO Conference in Tulsa, OK.*

TELETEC CORPORATION

Circle (4) on Fast Fact Card

Contents

Mobile Radio Technology

August 1991 Supplement — The journal of mobile communications technology

page 14

page 17

features

departments

On the cover: Photo courtesy of Ericsson GE Mobile Communications, Lynchburg, VA.

Communication Systems That Help You Get There On Time

When every second counts, you can count on Zetron's Emergency Communications Systems

- Central Communication Control Systems
- Desktop, Rackmount, and CRT Consoles
- Message Instant-Recall Recorders
- Pager and Tone Encoders
- Fire Station Alerting Systems

Call, fax, or write Zetron's Public Safety Division for information on our affordable and dependable communication systems.

ZETRON

12335 134th Ct. N.E. Redmond WA 98052 Phone: (206) 820-6363 Fax: (206) 820-7031

Circle (5) on Fast Fact Card

Public safety innovators lead digital radio evolution

Public safety agencies normally are among the first to implement communications technology advancements, and digital radio appears to be no exception.

Digital radio promises to deliver a wide variety of features, some anticipated and some yet to be devised.

Aside from sheer throughput gains from high-speed data transfer, digital systems offer an immediate doubling in radio spectrum capacity with a channel bandwidth reduction from 25kHz to 12.5kHz. An eventual reduction to 6.25kHz-wide channels is possible. Working 6.15kHz circuits have been demonstrated in the laboratory, but manufactured devices that can be sold at affordable prices and that can meet the technical requirements are years away.

Project 25

The Associated Public Safety Communications Officers (APCO) initiated Project 25 as a group effort to develop digital radio standards or a common air interface (CAI). A CAI ensures compatibility and interoperability among radios from different manufacturers.

An earlier APCO initiative, Project 16B, developed a more basic standard for trunked public safety systems. For many years, only one vendor offered equipment that met the standard.

It is much more likely that multiple vendors will build equipment with the common air interface to be defined by Project 25. The project involves state and local public safety agencies through APCO and the National Association of State Telecommunications Directors (NASTD). It includes the federal government and vendors.

With the common air interface, vendors have the opportunity to compete on the basis of features. Vendors that research the market, working with users to improve their communications, can use digital radio to create features that do the job.

Early adopters

Some public safety agencies may adopt digital radio even before Project 25 participants finish their work. The longer the project takes, the more likely this possibility becomes. APCO set an ambitious goal of one year for CAI development. That time has elapsed, but great progress has been made, as summarized separately below.

At least one vendor is ready to help agencies whose radio communications demands are so urgent that they cannot wait much longer for the additional capacity that digital radio will deliver.

The telling item is last on the list of CAI elements: the data frame structure. Depending on the resolve of the Project 25 participants to conclude their work, debate over the data frame structure could drag on long after the other four elements are defined.

Some vendors want the structure loosely defined, so they have maximum flexibility to devise and revise features to respond to individual customer needs. Some public safety representatives want the structure more closely defined so communications systems are more homogeneous nationwide.

Depending on how that debate unfolds by the end of this year, some agencies may move forward in cooperation with vendors to develop digital systems ahead of a CAI decision.

For their own sake, vendors cannot wait too long before offering digital radio products. They compete in a global marketplace that will not wait for a Project 25 decision. As important as the quality of Project 25 decision-making is, pressure to complete the work continues to increase.

In the U.S. market, three major radio communications groups are developing digital radio capabilities: public safety agencies, cellular telephone carriers and specialized mobile radio (SMR) system operators. Although the cellular community started its development first, look for public safety agencies to be the first to put operating systems on the air.

—Don Bishop

Digital radio

Digital public safety radio communications will be based on a common air interface (CAI) with five key elements that ensure unit-to-unit compatibility. The elements and their current status in the APCO/NASTD Project 25 are:

- ☐ ***Channel access method*—frequency division multiple access (FDMA) on 12.5kHz channels has been selected.**
- ☐ ***Modulation technique*—A modified quadrature phase-shift keying (QPSK) method is being evaluated.**
- ☐ ***Vocoder*—Four vocoders have been discussed, and a test methodology has been developed.**
- ☐ ***Channel data rate*—A 9.6kbps rate seems to be the front-runner.**
- ☐ ***Data frame structure*—A format for minimum requirements is being discussed.**

Attention technicians

APCO membership information is available from Adelaide Carter, APCO membership coordinator, 2040 S. Ridgewood Ave., South Daytona, FL 32119; phone 800-824-1850.

Command Performance

Magnasync's new Digital Voice Logger simultaneously orchestrates both record and playback, while it's digital retrieval system operates at laser disk speeds.

Because our DVL is a completely digitized machine, it can instantly locate any pre-recorded conversation for playback. And it simultaneously continues to record and time/date stamp all incoming messages currently being received on multiple channels.

Sound clarity is also optimal, thanks to our digital technology, and you'll be able to record from both radio and telephone communications.

Magnasync introduces the first-ever multi-channel, simultaneous record and playback Digital Voice Logger.

DVL also features fully-automated recording capabilities, insuring you're not wasting precious storage space if communication lines are not active.

Best of all, data is stored on a $5\frac{1}{4}$" digital cartridge. Providing on average more than two days of storage, while lasting more than a decade of continuous re-recording.

Our DVL is easy and convenient to operate. Its user interface includes a full- color monitor, complete with windows and help menus.

All this adds up to you spending more time helping the public and less time trying to operate the machine. So let DVL be instrumental to your success.

If you would like to be part of the latest in logging equipment, please call us at 1-800-366-3564. Or stop by booth 629/631 at the National APCO show.

magnasyncdigital®

conductors of technology

1135 Mansfield Avenue, Hollywood, Ca 90038, Phone 1-800-366-3564, Fax 213-962-8601

Circle (6) on Fast Fact Card

Letters to the editor

Public safety comments from Fast Fact Cards:

The toughest problems are:

- updating obsolete radio equipment.
- increasing repeater coverage on VHF radio systems.
- finding people to hire who know how to design and procure operational radio systems.

Jeff Haberstroh
Pennington County Search and Rescue
Rapid City, SD

The February issue is not as relevant to my work as other issues have been, but it seems informative in the respect that I can learn a little about other types of two-way radio.

The most interesting article in the issue is the editorial comment about unlicensed operation.

The two toughest problems on the job include:

- the challenge of expressing technical problems and limitations, as well as system operation and capabilities, to management.
- budget limitations that sometimes make it difficult to offer incentives and to hire the best available technicians.

Steve Riddle
North Carolina Emergency Management
Raleigh, NC

Although the February article by Selwyn Hill, "Computerized Diagnostics Boost Radio System Reliability," is very interesting, how many of us actually work on a type of system such as the Los Angeles Police Department's? How about some articles covering the use of data, including facsimile and packet transmission, on a system of 12 units rather than 9,000 units?

One of the toughest problems on the job is having to do "adaptive engineering" of different manufacturers products to meet customers' needs. For example, I've been told by the manufacturer "it *should* work," but it *didn't* work in the configuration in question.

Russell Streeper
Esco
Lynchburg, VA

The most difficult problems on the job include:

- finding communications equipment that rescue workers cannot tear up.
- maintaining adequate sound quality in high-noise situations.

G. McAlister
Paramedic and communications officer
Brown County EMS
Communications Division
Brownwood, TX

Mobile Radio Technology

The journal of mobile communications technology

EDITORIAL
Don Bishop, *Editorial Director*
Jane Bryant, *Staff Editor*
Nancy Campbell, *Associate Editor*
Liz Veternick, *Graphic Designer*
Jeri Robinson, *Paste-up Artist*

INDUSTRY CONSULTANT
Fred M. Link

REGULATORY CONSULTANT
Alan S. Tilles, Esq.; *Partner; Meyer, Faller, Weisman & Rosenberg P.C., Washington, DC*

EDITORIAL ADVISORY BOARD
Gene A. Buzzi, *President, Omnicom Telecommunications Engineering, Tallahassee, FL*
R. James Evans, *Communications Consultant, East Lansing, MI*
Gary David Gray, P.E., *Chief Telecommunications Engineer, Orange County Communications, Orange, CA*
Frederick G. Griffin, P.E., *President, Frederick G. Griffin P.C., Lynchburg, VA*
S.R. McConoughey, P.E., *Mobile Communications Consulting, Gaithersburg, MD*
Art McDole, *Salinas, CA*
F. Stuart Meyer, *Land Mobile Consultant, Vienna, VA*
Don R. Precure, *New Smyrna Beach, FL*
Herb Sachs, *Herb Sachs Consulting, Bowie, MD*
Leon Spencer, *Radio Engineering Systems, Exxon Company USA, Houston, TX*
Dr. Gregory M. Stone, *Vice President, Special Projects, Live Oak Systems, McLean, VA*
Raymond C. Trott, *President, Raymond C. Trott Consulting Engineers, Irving, TX*

BUSINESS
Cameron Bishop, *Group Vice President*
Mercy Contreras, *Publisher*
Greg Garrison, *Marketing Director*
Evelyn Hornaday, *Promotions Manager*
Darren Sextro, *Promotions Coordinator*
Dee Unger, *Advertising Business Manager*
Mary Birnbaum, *Advertising Production Supervisor*
Liz Turner, *Advertising Coordinator*
Lisa Cunningham, *Classified Advertising Coordinator*
Tom Cook, *Group Senior Managing Editor*

ADMINISTRATION
R.J. Hancock, *President*
Sandra Stewart, *Corporate Circulation Director*
Cindy Cardinal, *Circulation Director*
Christine Lotesto, *Circulation Manager*
Customer Service, *(913) 541-6628*

ADVERTISING: Northeast: Ruth Breashears, 303-762-1249; West Coast: Dennis Hegg, 415-491-1442; South: Diane Hite, 303-762-1249; Midwest: Nancy F. Matthews, 312-435-2340; Classified: Carla Gamino, 303-762-1249.

CORRESPONDENCE: Editorial, advertising and circulation correspondence should be addressed to P. O. Box 12901, Overland Park, KS 66212-0930, 913-888-4664, telex: 42-4156 INTERTEC OLPK, fax: 913-541-6697.

MOBILE RADIO TECHNOLOGY provides technical information to dealers, community repeater operators, specialized mobile radio operators, conventional and cellular RCC and WCC, mobile radio equipment manufacturers, manufacturers' representatives, distributors, engineering/consulting firms, national/state/local government, military agencies, public safety agencies, transportation companies, petroleum/energy products companies, public utilities and others allied to the field.

SUBSCRIPTIONS: MOBILE RADIO TECHNOLOGY is circulated without charge in the United States by name and title to personnel who are responsible for sales, operation or maintenance of mobile radio equipment. Non-qualified subscriptions in the United States are $30 per year; In Canada, $36 per year; and in other countries, $40 per year. Foreign airmail optional at an additional $65 per year. Single copies are $3 plus postage and handling; back issues, $5 postpaid. Adjustment necessitated by subscription termination at single copy rate. Allow six to eight weeks for change of address or for new subscription.

$3.00 + 0.00

BPA ABP

Audited circulation.

INTERTEC PUBLISHING

"Things have never been more like the way they are today in history."
-Dwight D. Eisenhower

"Gerald Ford is a nice guy, but he played too much football with his helmet off."
-Lyndon B. Johnson

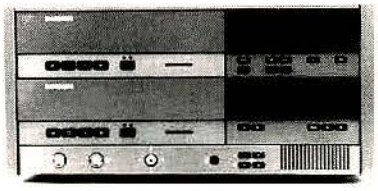
"I would not like to be a political leader in Russia. They never know when they're being taped."
-Richard Nixon

"The thought of being President frightens me and I do not think I want the job."
-Ronald Reagan in 1973

"I stand by my misstatements."
-Dan Quayle

After 40 years of working for the government, we've heard it all.

People took a liking to Racal Recorders even before they liked Ike. Since 1950, Racal instrumentation recorders have been used by the government for such purposes as defense, aerospace, military transport, and naval operations.



Our voice logging equipment has become just as popular. From the four-channel TK0401 to the 32-channel Wordsafe to the 64-channel I.C.R. 64, each Racal recorder is designed to keep up with growing demands.

So whether you're the president of a brokerage firm or the President of the United States, we've got a recorder to fit your needs. Just call (800) 847-1226 to find out more. In California, call (714) 727-3444.

RACAL
Reaching beyond today's standards

Racal Recorders, Inc., 18 Technology Dr., Suite 100, Irvine, CA 92718

Circle (7) on Fast Fact Card

Routine maintenance reduces malfunctions

Routine maintenance has a place in every radio service shop. Here are some procedures to perform during slack periods in regular public safety radio service work to reduce malfunctions and complaints.

By Roald Steen

The workload in a mobile radio service shop usually consists of repairing and servicing equipment that has malfunctioned. But there also is a place for routine maintenance.

In the early days of mobile radio communications, equipment had to be checked regularly. Vacuum tube radios often drifted off their operating frequencies as crystals and tubes aged and as other components suffered from the effects of heat and vibration.

Today's mobile radios are more reliable. Many retain their frequencies within specifications for years. Transmitter modulation levels and receiver sensitivity figures rarely change by much.

There is a certain amount of truth to the saying, "If it ain't broke, don't fix it." Yet there is a place in all mobile radio systems for routine maintenance. Although much of this work is for light workload periods, some maintenance must be made an ongoing task, and much can be accomplished simply by monitoring the radio system.

Now and then, monitor all the channels used by equipment maintained by the shop. Use a scanner most of the time, and occasionally dial individual frequencies on the service monitor and spectrum analyzer.

As you monitor radio channel traffic, sometimes you will hear mobile units that do not sound as good as the others. The problem may not be so serious that the officer has reported it as a malfunction requiring a service call.

Steen is an electronics instructor and two-way radio technician who lives in Woodbury, MN.

When most of the radios are brought to one location, such as during a shift change at a police station, it may be a good time to use a service monitor to verify that all portables and mobiles are on frequency and well modulated.

Make note of the units that sound inferior. You may want to call the vehicle into the shop to check the radio equipment. If it is better not to interfere with the regular use of the vehicle, arrange to be notified when it is taken out of service routinely. For example, you may ask the garage to notify you when the vehicle is brought in for mechanical service.

Monitoring all the channels routinely reveals when a repeater develops a problem, such as drifting off frequency. And you can become familiar with each channel's modulation quality. When you hear noisy modulation in certain situations, check lines, satellite receivers and other possible noise sources.

Technicians who visit a remote site are well advised to check routine operating values of all repeaters at the site, provided there is no special reason to cut the visit short. Measure each repeater's frequency, power output, reflected power, transmitter modulation and receiver sensitivity and enter the values in a log at the site. When the log reveals a change in these values, it is time to investigate.

Clean equipment works best. Use an air blower or vacuum cleaner to clean equipment that is in service. Be careful around parts of the system that may carry high voltage.

Radios removed from a vehicle taken out of service or removed for other rea-

sons should be subjected to a complete check before reinstallation. Check frequencies, modulation, power, sensitivity and received audio distortion. Make sure everything is as clean and free of evidence of wear and tear as possible.

Control heads and control cables removed from vehicles taken out of service should be inspected. If the control cable shows signs of heat damage, discard it. Check switches and connections inside the control head. Make sure the control head looks good; it is one of the most visible components.

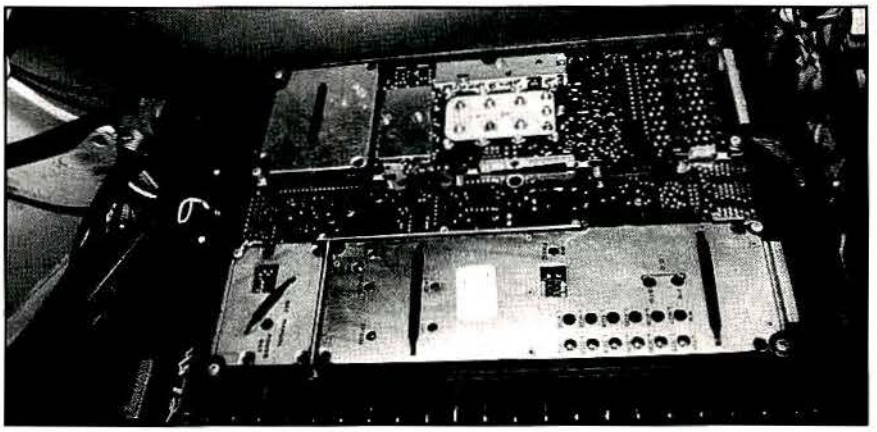
Dust tends to accumulate inside electronic circuitry, partly because electrical charges attract dust. The unit may be cleaned with a vacuum cleaner or air blower. Turn off all equipment before cleaning its interior.

Clean the air filters in the air changing systems that cool repeaters and other equipment. Some require new filters at intervals; others have filters that can be cleaned.

Fan motors, electrical motors and other moving parts work better with periodic maintenance procedures. Check equipment manuals to determine what kind of maintenance is needed, and how often.

Some maintenance procedures should be scheduled seasonally. Required outside maintenance might be scheduled for summer, to reserve the winter season for inside maintenance.

Sometimes, it may be advisable to visit sites equipped with numerous radios to make quick frequency and power checks. At some locations, more radios are brought together at some times than at others. For example, at police precinct stations, almost all officers on a shift may be present during a shift change. The shift change may give you an opportunity to check portable and mobile equipment with an FM service monitor and wattmeter.



Although most mobile radios contain highly stable crystals or frequency elements, an occasional frequency and modulation check reveals problems in time to prevent malfunctions.

Vehicle use may be seasonal. Snow plows are needed during the winter, so a good time to check their radios is shortly before the onset of winter.

Other vehicles see use mostly during summer, including landscaping equipment and park patrol service vehicles. Late winter or early spring may be a good time to inspect the radios.

Check your telephone lines and proprietary lines periodically for frequency response, attenuation and noise. If you see a significant change in any of these features, you can take steps to correct the deficiency before it develops into serious trouble.

Vacuum tubes are well instrumented in the relatively few pieces of modern equipment that use them. Instrumentation may include readings for plate voltage, plate current, grid current and screen current, to allow you to see when tube performance begins to deteriorate. When tube performance drops, change the tube before it degrades far enough to disable the repeater or other equipment.

Keep a log of tube readings and make entries during each visit to the site to reveal reduced performance that requires tube replacement.

Emergency power supplies need periodic maintenance. Some types of batteries, including lead-acid batteries, need to be refilled with distilled water when the electrolyte level falls below a certain level. Emergency electric generators may need periodic oil changes, tuneups and spark plug changes.

It is not uncommon to find that coffee or a soft drink has been spilled on equipment. Base station operators sometimes use consoles as tables for coffee cups and soft drink cans. If you see dried spills on the mobile data terminal, control head or siren control, it is a good idea to clean the spill before the vehicle leaves the radio shop.

Siren speakers and outside intercom speakers on vehicles may freeze during the winter. Siren speaker manufacturers make fabric covers for the speakers. Cover the speakers before the onset of winter, and remove them when warm weather returns.

Proper maintenance procedures help to keep equipment operating well and to prevent it from interfering with other radio users. Keeping equipment clean and well serviced also improves operator satisfaction.

Ongoing maintenance

- ☐ **Monitor the radio system.**
- ☐ **Check and log routine operating values at repeater sites.**
- ☐ **Conduct performance tests on all units before installation.**
- ☐ **Clean air filters; remove accumulated dust.**
- ☐ **Service equipment that has moving parts.**
- ☐ **Conduct performance tests on dedicated telephone lines.**
- ☐ **Check stationary batteries and fuel-powered generators.**

Fixing noise problems in public safety systems

Noise problems often are concealed because their effect may be misleading, such as an apparent loss of receiver sensitivity. Experience and, sometimes, diplomacy are called into play to find solutions.

By Roald Steen

Noise problems are among the most difficult problems a two-way radio technician encounters. Various types of noise and noise sources persist in public safety vehicles, department offices, industrial buildings and the city environment. Sources increase as more computers and electrical equipment come in to use.

A mobile radio user may describe a problem as noise, but something other than noise may cause a radio to be noisy. Most noise problems affect reception, but some may cause a transmitter to malfunction. Transmitter problems most often are evidenced by the transmitter being heard outside its assigned frequency.

In vehicles, most noise problems happen when the engine is running. Testing for a radio noise problem may require the engine to be running, so it should be done in a well-ventilated area.

Troubleshooting equipment

The spectrum analyzer is a great help in tracing noise problems. As you watch a display of noise on the analyzer, it shows an increase in strength as the analyzer probe is brought nearer to the noise source. Use an RF "sniffer" probe to look for noise sources. An RF sniffer is a length of coaxial cable terminated in a small loop antenna.

As a substitute for the analyzer, a small radio may be used to isolate noise sources. On an FM radio, an indication of IF signal strength ahead of the limiter circuit is needed for following noise strength variations. An AM shortwave radio can provide an audible indication and may be equipped with a signal strength meter.

Although "sniffing" for a noise source may isolate the source, the method has limitations. Some electronic noise is inevitable with some equipment. For example, there always is a great deal of RF noise under the hood in a vehicle when the engine is running. The problem is to determine when the noise is of a type and strength that is beyond normal.

One of FM's advantages over AM is that many types of noise are not heard. Noise appears as amplitude variations on the received signal, not frequency variations. If the received signal exceeds the limiter level, noise in the form of amplitude variations on the received carrier normally are clipped by the limiter circuit and not heard.

Desensitization

Although many noise sources cannot be heard on an FM radio, especially if continuous-tone controlled squelch system (CTCSS) or digitally controlled squelch (DCS) is in use, the noise still can cause problems. For example, a radio with 0.5μV sensitivity cannot deliver weak-signal performance if it is used in an environment with tens or hundreds of microvolts of noise. The noise desensitizes the entire system, and the radio only receives signals that exceed the noise level.

When you have determined that the vehicle has a noise problem, the first test to conduct is the simplest. Disconnect the coaxial cable from the radio to see whether the noise stops. If it does, the noise is entering the radio via the antenna or, more rarely, the coaxial cable.

The coaxial cable can pick up noise if it is routed through an extremely noisy environment, or if it is defective. To eliminate the cable as part of the problem, reconnect the coaxial connector and remove the antenna whip. If the noise remains, it is entering via the coaxial cable. Replace or reroute the cable.

Power wiring

Radio noise often is present even with the coaxial cable removed from the radio. When it is, the noise is entering via the power wiring.

Noise sources

- ☐ Engine ignition.
- ☐ Alternator.
- ☐ Accessory equipment.
- ☐ Wheels.
- ☐ Spurious emissions.
- ☐ Malfunctioning filters.
- ☐ Computers and microprocessors.
- ☐ Lights and appliances.
- ☐ Intermodulation interference.
- ☐ Electrical utility.
- ☐ Electric motors.

Steen is an electronics instructor and two-way radio technician who lives in Woodbury MN.

Noise may enter the radio not only through the cable that powers the receiver, but also through the heavier cable that powers the transmitter.

To see whether the noise enters via the transmitter power cable, remove the cable's in-line fuse. If the noise stops, it is entering via the transmitter power cable. Otherwise, it is entering via the receiver power cable. It may be entering via both.

Noise picked up by the power wiring may be reduced by rerouting the wiring. The receiver power cable is especially vulnerable to noise if it is routed near the ignition module.

Another possible way to reduce the noise pickup is to connect the receiver power cable to a different point on the vehicle electrical system.

Under the hood

The highest levels of RF noise in the vehicle are found under the hood. Also under the hood is the battery, which works not only as a power storage device but as a huge capacitor with the ability to smooth out RF noise. The battery usually is the point in the vehicle with the least RF noise.

Noise entry points

- ☐ **Antenna.**
- ☐ **Coaxial cable.**
- ☐ **Power wiring.**

A possible solution to an RF noise problem is to connect the receiver power cable directly to the battery. You can substitute a shielded cable for the usual red wire, or install an in-line choke inductor or an additional capacitor across the receiver power cable and vehicle ground.

None of these remedies work in all situations, so it is a matter of trying to determine what will work. If the receiver power cable is connected to a 12V source under the control of the ignition switch, the noise problem may be reduced by connecting the cable to a different point on the fuse block under ignition control.

Even though most noise problems are associated with reception, either in the form of reduced sensitivity or audible noise, some noise problems may occur during transmission. Suspect noise as the cause if you hear a mobile's transmitter on nearby channels in addition to its assigned frequency. The transmitted spectrum may look fine on a spectrum analyzer when the radio is removed from the vehicle, or when the vehicle engine is turned off.

The spurious emissions are caused by a strong noise source in the vehicle that modulates the carrier amplitude. If the modulating noise is strong and its waveform has a sharp rise and fall shape, it will produce a number of sidebands. The sidebands appear as interference on nearby channels, often in such a way that operators on other channels can hear the mobile signal and understand it as clearly as those who listen to the correct transmitter frequency.

Isolate the noise source by turning the

various vehicular electrical systems on and off. When the electrical system causing the noise is switched off, the sidebands will disappear from the spectrum analyzer screen as the mobile transmits.

Alternator noise

An open diode in the vehicle alternator causes strong noise pulses on the entire vehicular electrical system. It can make noise pulses strong enough to cause sidebands to spill into other channels during transmission.

Other parts of the communications system can cause the noise. I have seen it happen many times as the result of a malfunctioning mobile data terminal filter circuit. The malfunction causes an oscillator in the mobile data terminal to modulate the radio transmitter. The cause is isolated by transmitting with the mobile data terminal switched on and with it switched off as the signal is displayed on the spectrum analyzer.

Computers and microprocessors emit a great deal of radio noise. Take that into account if the noise problem appears as reduced sensitivity on radios operated in buildings that house many computers.

If the antenna is near a computer, noise from the computer can cause a loss of receiver sensitivity. The cause is isolated by turning the computer on and off.

Some computer systems cannot be switched on and off as a personal computer can. If the computer cannot be switched off, experiment by moving the antenna to other locations.

TV sets, fluorescent lights, lamp brightness controls, appliances and microwave ovens are among sources of RF noise that are becoming more common. Isolating a noise source to one of these objects is done by seeing what happens when you turn the suspected device on and off. Because some noise level is inevitable, these problems may have to be solved by relocating the device that causes the noise or by relocating the antenna.

Intermodulation interference (intermod, or IM) is a special form of noise that tends to occur in radio sites with a number of radio transmitters. Intermod occurs when an unwanted signal, perhaps emitted by a nearby transmitter, mixes with a signal in your receiver or transmitter circuit—or someone else's.

Intermod is another type of problem that can be traced with a spectrum analyzer. Once the cause has been isolated, the problem usually can be alleviated by using tuned cavities and other filtering devices to block the unwanted signal from entering the affected system, mixing with another signal and being retransmitted as interference.

Intermod sometimes causes bad feelings between colleagues in the mobile radio business. Because two individuals or organizations often are involved in an intermod problem, it is not unusual for each to blame the other. But the truth is that intermod may occur even when both radio systems are operated within their technical specifications.

Fixing the problem often requires cooperation between the two parties involved, or even more participants. Although intermod is beyond the scope of this article, William F. Lieske's book *Intermod Control* contains many suggestions for dealing with the problem.

Electric utility

Some noise may originate with the electric power utility equipment. Corona and sparking cause noise that may be carried by the ac lines. Line noise tends to decrease as the radio frequency increases. Electric lines always emit some RF noise, the challenge is to determine when it is at an abnormal level.

Use the spectrum analyzer to determine whether a strong noise emanates from nearby power lines.

If you are certain that the line noise is excessive, call your electric utility. But keep in mind that sometimes it is easier to relocate your antenna than it is to isolate the cause of excessive line noise, even when the utility cooperates.

All electrical motors cause some RF noise. The noise they generate may cause a problem because some of the largest electrical motors in many buildings are the elevator motors in the penthouse atop the building. The penthouse may be close to, or even support, the antenna system for base stations or repeaters in the building. It is not unusual for the repeaters to be housed in the same penthouse as the elevator motors.

Problems caused by RF noise from the elevator motors may be reduced by trying different antenna locations and using gain antennas mounted higher than the motors to take advantage of any nulls in the antenna emission pattern.

Experience and proper instruments, such as a spectrum analyzer, are among what is needed to solve RF noise problems. Sometimes diplomacy is valuable. Solving noise problems may be among the biggest challenges you face in operating or repairing a two-way radio system.

Additional reading

1. Campbell, Dereck B., "Eliminating Interference in Today's Electronic Vehicles," *Mobile Radio Technology*, November 1986.
2. Ericksen, J.H., "The Nuts and Bolts of Intermod," *Mobile Radio Technology*, September 1984.
3. Hendershot, James, "ACSSB Outperforms FM in Ignition Noise Tests," *Mobile Radio Technology,"* August 1984.
4. Lieske, William F., "How To Use Hybrids To Combine Transmitters," *Mobile Radio Technology*, September 1987.
5. Lieske, William F., *Intermod Control*, Wiesner Book Company, Englewood, CO, 1984.
6. Taggart, Harold E., "How To Suppress Automotive Interference," *Mobile Radio Technology*, May 1986.

Back issues of *Mobile Radio Technology* are available from Intertec Publishing (telephone 913-541-6628) only for editions published within two years of the present date. Although the issues listed above may be available in libraries, they are unavailable from the publisher. *Intermod Control* is available from Wiesner Publishing, telephone 303-397-7600.

Equipment installation for public safety vehicles

Analyzing the characteristics for public safety's mobile environment can mean the difference in effective and ergonomically sound installations.

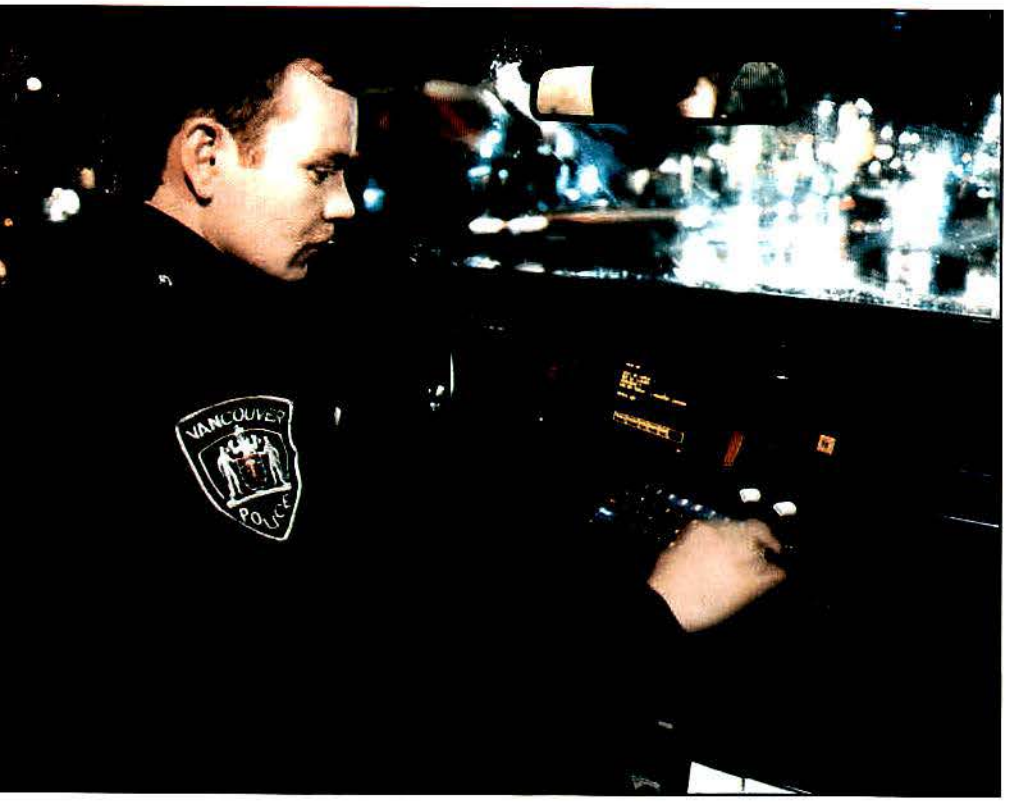
By *MRT* staff

Installing communications equipment, as well as specialized public safety equipment, in vehicles requires consideration of the uses for such equipment. The vehicle operator should be able to reach all important controls without altering position or looking away from the road.

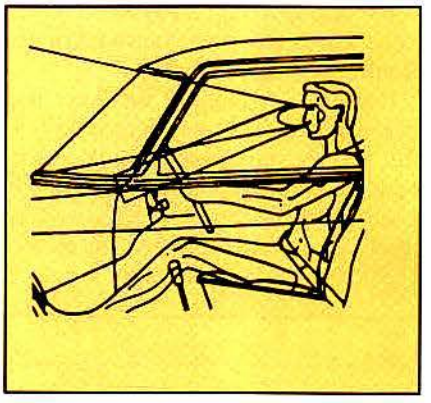
Considering that this equipment will be used in inclement weather, darkness, dense traffic and other such factors, the public safety officer's capability to interact with the communications equipment should be examined.

Careful identification and analysis of ergonomic issues will yield answers to help you to solve public safety communications equipment installation problems.

First, analyze equipment installations to verify that the public safety officer can reach all controls without altering position or looking away from the road.



This mobile data terminal is positioned for an easy reach from the driving position.



A driver's eye travel distance from forward visual scene and preferred maximum visual travel.

Typical equipment installed in public safety vehicles

- ☐ Mobile radio
- ☐ Mobile data terminal
- ☐ Input keypad
- ☐ Mounts
- ☐ Radar
- ☐ Siren activation switch
- ☐ Light bar activation control

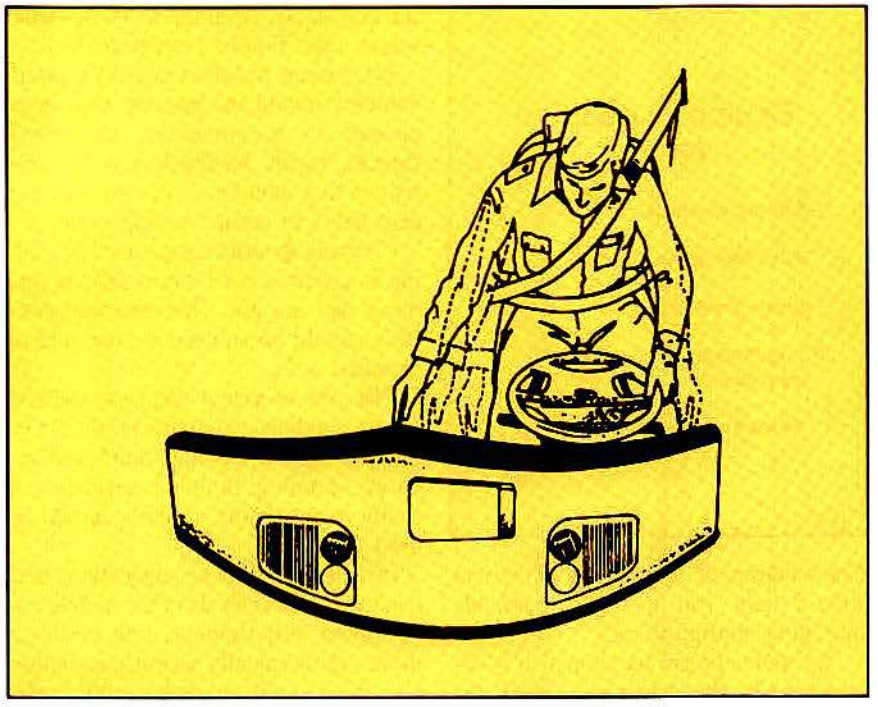


Figure 1. Dashboard controls positioned within easy reach. Installations in public safety vehicles should enable the driver to sit normally in the seat and yet reach all essential controls. Non-essential controls should be located on the side of equipment.

A careful review of sound ergonomic design principles should be employed to ensure the mobiles, data entry devices, mobile data terminals and other equipment used in the vehicle have been designed with the public safety officer in mind.

Handsets should be easily accessible, as should mobile data terminals. Many mounting hardware manufacturers offer a wide array of mounts and accessories to satisfy various mounting needs.

Controls and displays on equipment should be simple—not overly complicated. They should be large enough for a vehicle operator to access without requiring significant time away from watching the road.

Another relevant principle of control location is comfortable reach. All controls should be within a distance that allows the public safety officer to operate them without moving away from the normal driving position. Comfortable reach lengths are considered to be shorter than maximum reach lengths. Driver reach capabilities play an important

Installation factors to consider

- ☐ Equipment uses
- ☐ Ergonomic design
- ☐ Operator accessibility
- ☐ Mounting options and hardware

Equipment design factors

- ☐ Simple controls
- ☐ Easy-to-read controls
- ☐ Large controls
- ☐ Location of non-essential controls on side of unit
- ☐ Proper spacing among controls

role in communications and related equipment installation.

Because there is such a difference in interior design among various makes and models of vehicles, there is no constant fixture on which to surface-mount communications and other control units. Consultation of mount manufacturers should help you to find a suitable mounting configuration.

Optimum control location also is determined by the driver eye travel distance from the forward visual scene. There should be minimal vertical eye travel distance from the forward visual scene. (See Figure 1 on page 14.)

Equipment installed in public safety vehicles should incorporate keys large enough to accommodate the user's fingers, tactile feedback and the corresponding numbers. Proper spacing also helps to reduce keying errors.

Controls should be organized according to controls used while driving and those that are not. Non-essential controls should be situated on the side of installed units.

The size of visual displays, such as words, symbols and numbers, should be large enough to facilitate quick and accurate scanning. Simple letterform and easily recognizable symbols should be used.

Incorporating these suggestions and conducting an analysis of the mobile environment requirements will ensure a more ergonomically sound installation and one that will make the public safety's officer's in-vehicle tasks easier.

Beyond laptop computers in data communications

Information is the future. New technologies and philosophies will provide tools for public safety agencies to serve that future. Radio-computer combinations will become common in the field.

By John D. Abbey

Digital radio and increased use of data communication promise to stretch the overburdened public safety radio spectrum as trunking and packet-switching have begun to do.

Information is becoming increasingly important. Crime analysts, deployment strategists, financial administrators and even field officers share event and crime data. Fire departments retrieve plans and inspection data from computers to fight fires and handle hazardous materials (hazmat).

Thus, communications and computers are becoming one. First, mobile radio extended human communication. Second, computers stored and analyzed information, and passed it through modems to the field via mobile data terminals and laptop computers.

In a third wave of change, vast amounts of information are collected, processed and packaged for easy understanding. New systems and philosophies are evolving to deliver only essential data, converted to an understandable, concise format.

As much as 70% of America's current response-oriented, reactive law enforcement may convert to a proactive, problem-identification-and-solution approach by 1995, overshadowing today's focus on 9-1-1. Department strength, now measured in officers-per-thousand (population), will be measured by how effectively information *from the community* is collected, analyzed and distributed to officers.

Data processor specialists will build the software to *manage* the information. Communications specialists will *distribute* the information.

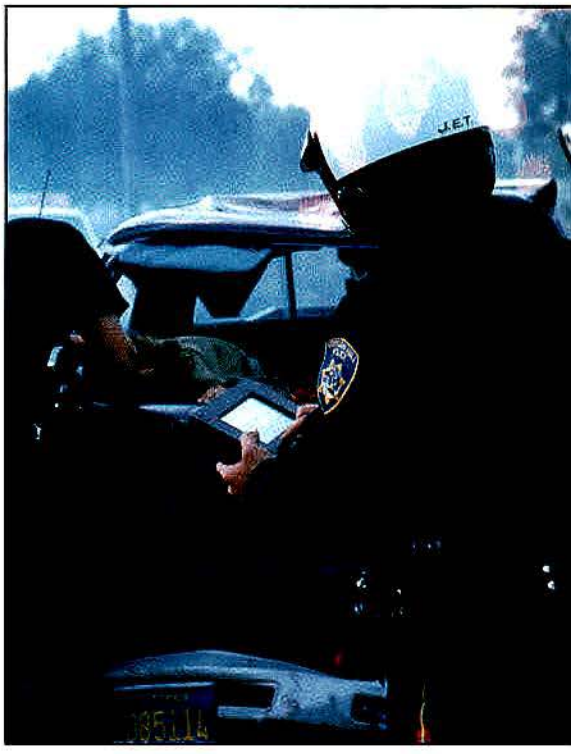
Community policing depends on *community condition* (precursors to crime) reports that include far more than the victim, witness, suspect, service call and crime analysis information captured by today's system. *Untethered workstations* and hand-held computers designed into tomorrow's communications network will put the power of information into the hands of the officer, firefighter and paramedic. Some police administrators see these portable devices not only as a means of communications but as a field interface to automated *problem-solving databases,* the backbone of community- or problem-oriented policing.

Abbey is president of Abbey Group, Grass Valley, CA, and he is a retired police chief with experience in developing innovative technologies. Abbey's graduate study in futuristics and business led to a second career in consulting to government agencies and technology companies.

From laptops ... to the future

Just when some agencies are looking to laptop computers for *intelligent devices* in the patrol car, technology is passing them by. Several agencies have replaced traditional mobile data terminals (MDTs) with full-featured *fliptop* laptop computers. They perform many of the MDT's computer-aided dispatch (CAD) functions, plus they run standard disk-operating system (DOS) programs with graphics, such as vivid maps and digitized photographs. Modems that allow intelligent devices to work on high-efficiency MDT systems are available.

Yet these advances in field computing look meager compared to emerging technology: the hand-held, communicating microcomputer or workstation that includes a radio modem. Miniature transceiver-modem combinations do not have to be vehicle-mounted. They take computing to the street.



An untethered, hand-held computer allows a police officer to transfer information between an accident scene and state and national public safety databases.

Invisible network

Even the smallest modern communication system must include *mobile data.* Nationwide, agencies dedicate frequencies to data and explore other methods. Those without a dedicated *data-radio system* can subscribe to one of several

public networks designed to cover the country, including at least the mid-sized-to-major-city market.

Some of tomorrow's solutions may be found in today's technologies. The Memphis Police Department shares a specialized mobile radio (SMR) system for field computing to access local, state and national records. According to department commander Jim Tusant, "The whole idea is to move from one select vendor to an open architecture."

Open systems, which represent an accepted standard in computing, are the enemies of proprietary data communications system vendors. With few exceptions, dissimilar computer operating systems can communicate through data links and protocol standards. Public safety agencies can share data, and data-sharing extends to the field.

Beyond the laptop

Future advances in field computing reside in efficient networks that provide access, transparently to the user, to all public safety and criminal justice system levels. State and national databases become a resource for the field officer.

For the firefighter, national hazmat databases and diagrams of hydrants and building plans will be on line. Paramedics will have telemetry and text links. These emerging networks combine wide-area-networks (WANs) and local-area networks (LANs) on scales ranging from nationwide systems to agency operations.

WANs include computers in emergency vehicles. These WANs (sometimes called MANs, as in metropolitan-area networks) interconnect *geographical locations*, whereas LANs serve users within a *confined area.*

The first interactive, field-computing laptop WAN system was activated in the Morgan Hill, CA, police department. Next, officer Alec Gagne, the project manager, teamed with officer Wally Briefs of the Sunnyvale, CA, Department of Public Safety to design the *mobile computing system* (MCS). It brings full computing power to the emergency vehicle, overcoming the physical and technological barriers of laptop PCs.

The MCS is vehicle-bound, but the Morgan Hill laptops bolted into police vehicles are, too. The MCS is designed around a multislot 80286 or 80386 personal computer (PC) chassis, shock-mounted in the trunk. A cable harness connects the display and keyboard in the driver's compartment.

The keyboard is separate and mobile. Compatible off-the-shelf infrared (IR) keyboards are available for these PC-compatible MCS configurations, allowing for key entry outside and adjacent to the vehicle.

The MCS has as much as 8 megabytes of random access memory (RAM) that can store graphical data, such as maps, in instantly retrievable memory. The laptop pilot project revealed a potential weakness in having access to a movable hard disk while driving, a deficiency the MCS reduces or eliminates. The MCS has add-on slots and space for a hard drive. But with constant power

provided by the host vehicle, the computer's volatile RAM is retained even when the vehicle engine is off.

The MCS' highly capable technology platform becomes the public safety employee's office. With a high-efficiency radio-modem combination, the MCS becomes a remote processor capable of processing and communicating information off-line from the user. Information can be received, stored and forwarded without user intervention. Priority codes allow emergency data to be broadcast before or in between time-consuming transmissions of long messages and graphics.

The MCS has the power, processing intelligence and additional features to realize the full potential of global positioning systems (GPS). Economical mapping software can be linked to GPS and CAD systems to provide instant geographical response information.

One technology that shows incredible promise is reasonably priced spread-spectrum radio communications. Changes in FCC Part 15 rules allow low-power, short-distance communications in the industrial, scientific and medical (ISM) frequency bands. These products use spread-spectrum technology similar to the military's use. Using high-speed data over spread-spectrum radio, the MCS can become the hub of information activities in the field.

Electronic clipboard

The ideal public safety technology automates functions already performed by officers, firefighters and paramedics, such as communicating handwritten information. For example, a hand-held computer that recognizes block printing written on its screen with an electronic stylus converts the information into standard characters used in almost all open-architecture computer systems. Touching *checkboxes* with the stylus sends status messages.

An untethered, transportable device allows the public safety officer using a spread-spectrum transceiver to communicate across 1 kilometer to the host emergency vehicle. Operating at a faster data rate than the RF link from the vehicle to the station, the 121kpbs-to-242kpbs spread-spectrum radio link draws upon the MCS' immense data storage capacity. The spread-spectrum link creates the system's LAN element.

Although still in their embryonic stage, these public safety technological advances are expected to support major strides in applications software development. New software will allow *artificial intelligence* expert systems to process vast amounts of incoming and stored data and present only the most important information to the manager, fire ground officer and crime scene officer.

Rather than producing long, textual investigation reports, artificial intelligence systems use an *expert decision tree* to gather information quickly. Expert investigation systems will interact with all criminal justice data levels, condensing hours of repetitive human activity into seconds of automation.

As public safety employee salaries

Continued on page 32

Procurement practices for communications systems

Understanding the major procurement methodologies helps purchasers and vendors who participate in government procurements. Methodologies should be chosen to fit the specific procurement situation.

By George W. Weimer, P.E., and John G. Griesel, P.E.

Each year, immediately after the new budget year begins, governmental departments begin telephoning, writing and visiting their purchasing departments to find out how soon they will be getting their new equipment. The attitude usually is: "We needed this four years ago. Last month, we had four crews sitting around because we didn't have the equipment. The people in City Hall finally approved it for this year, so what's the holdup? And, by the way, we aren't going to get those same crummy units you bought the last time, are we?"

As understanding as purchasing department employees may be and as flexible as procurement procedures may be, the purchase of modern, reliable and high-performance equipment must follow established procedures to comply with codes, ordinances, statutes and good accounting practices.

Weimer is vice president of engineering, and Griesel is director of public safety systems at Raymond C. Trott Consulting Engineers, Irving, TX.

Procurement methods

- ☐ Requests for bids.
- ☐ Request for proposals.
- ☐ Request for information.

Most, if not all, state and local governments are prohibited by law from entering into a negotiated agreement and bypassing the competitive procurement process. The only exception is the seldom-used sole-source procurement.

Because requests for bids and proposals are facts of life for both buyers and suppliers, all the major procurement processes will be discussed, along with the concerns of buyers and suppliers. Although some issues may seem elementary, it is surprising how many people on both sides of the procurement process do not understand the process concepts and details.

Sole-source procurement

Sole-source procurements are not used widely because they usually require detailed justification and advance approval in accordance with state or local statutes or ordinances. These statutes and ordinances provide exceptions to the competitive procurement requirements. The most common use of sole-source procurement is for emergency purchases necessary for service restoration.

Most buyers would rather proceed under a competitive procurement and state their requirements so that at least one supplier is capable of conforming to the specifications than attempt to justify a sole-source procurement. This approach is not always the best.

Governmental purchasing agents usually are skeptical that the specifications are too restrictive if only one proposal is received. In some cases, receiving only one proposal or bid results in delays to the procurement process while the procurement specifications are evaluated for restrictiveness.

In a case where expansion or enhancements to existing systems are to be procured, there may be only one source of procurement, the original supplier. If the expansion or enhancement is of major scope, competitive procurement in an area where high markup or severe discounting is prevalent may allow a complete upgrade in equipment and technology for a cost similar to a sole-source expansion.

Sole-source procurement

- ☐ Used to make emergency purchases to restore service.
- ☐ Used for purchases that expand or enhance existing systems.
- ☐ Requires a definitive contract.
- ☐ Should clearly define warranty and maintenance responsibility.
- ☐ May be subject to protest and litigation.

Definitive contract

Issues such as overall responsibility for performance and maintenance of the expanded or enhanced system should be of major concern to both the buyer and supplier. Therefore, sole-source procurements should be achieved

through a definitive contract jointly developed between the buyer and the supplier with responsibilities identified. Otherwise, a purchase order, along with the supplier's terms and conditions, may prevail unless contradicted by the buyer's terms and conditions.

Occasionally, authorized dealers provide their own warranty and maintenance instead of the manufacturer's warranty and maintenance. Buyers may procure a false sense of security when buying new equipment from an authorized dealer rather than the manufacturer, and this situation may not be apparent in a purchase order. The issue becomes apparent through appropriate joint development of a contract when the warranty and maintenance responsibility terms are negotiated.

If the original procurement was accomplished through an equipment manufacturer that restricts distributors from selling the necessary products, the only procurement avenue may be the sole-source procurement from the manufacturer.

Some manufacturers commonly allow their distributors or affiliated sales organizations to provide add-on equipment sales and services.

If the manufacturer restricts sales organizations to a specific territory or region and agrees not to compete with the sales organization, there still may be only one source. But if several organizations have the ability to provide sales and service, the procurement may be restricted to one brand of equipment, yet competition may be available among the various sales organizations.

As mentioned before, be sure that the offering includes warranty and maintenance backed by the manufacturer, not just the sales organization.

Sole-source approval

Sole-source procurement, where there is only one manufacturer or source, may be justified, and the time involved in the entire process may be minimized by obtaining approval for a sole-source procurement.

This approach may result in a protest after the fact if the purchaser is not aware of other sources. Protest and litigation may delay the procurement beyond the point where alternative procurement methodologies could have been completed. Should other sources be uncovered, the entire procurement may be rejected and the process redirected toward a competitive procurement, resulting in much wasted time and energy.

If a governmental agency thinks it can justify a sole-source procurement, by all means discuss the matter and the risks throughout the entire organization and proceed in that direction only with adequate consensus and support. It may be a proper means to your goal, but there are some risks involved.

Requests for bids

The intent of a procurement specification document is to provide the purchaser with an unbiased procedure to obtain the equipment or services required by restricting the vendors' responses to those items that comply with the required equipment, services and conditions of purchase. The bid award normally is made to the lowest-cost, fully compliant bidder.

The requests for bid (RFB) procurement procedure usually is limited to purchases or orders of known, mature products and devices. It is used to prevent an aggressive vendor from attempting to define the purchaser's requirements, usually around the vendor's product line. The RFB specification should provide information that clearly and technically describes those items and functions the purchaser requires. After bids are received, the purchaser may conduct an objective and comprehensive bid evaluation based upon technical competence and bid price.

To prepare a bid specification to permit this procedure, the purchaser must clearly define and document the purchase requirements. This may require the purchaser to review offerings from several vendors.

Historically, some bid specifications were essentially a one-paragraph document that stated something similar to: "The City of Lonesome Oaks wishes to purchase a split-phase wobulator such as the Premium Industries Model 1000 or the ABC Corporation Defender Model. Any other model bid must be approved by the purchaser prior to bid date."

In the past, the use of these "such as" clauses as a purchasing tool reflected the marketing successes of companies such as Premium Industries and ABC Corp.

As vendors enter the marketplace with new, more sophisticated product offerings, the purchaser is flooded with more information to evaluate before buying. The decision has become one of selecting which brands and models meet the immediate and foreseeable needs of the purchaser, and which ones will not be satisfactory.

Information-gathering

To gather this information requires much more effort than setting aside an

Requests for bids

- ☐ **Used for purchases or orders of known, mature products and devices.**
- ☐ **Prevents vendor from defining purchaser's requirements.**
- ☐ **Requires bid evaluation.**
- ☐ **Should define and document purchase requirements.**
- ☐ **Involves information-gathering.**
- ☐ **May place responsibility for system integration engineering on purchaser or supplier.**
- ☐ **Request for bid statements should include:**
  1. **the bid opening date.**
  2. **the bid submittal location.**
  3. **the purchaser's bidding and payment terms.**
  4. **any requirements for submitting bonds.**
  5. **a representative of the purchaser who can answer questions during the bid preparation.**

hour or two for the one or two energetic vendors, as in the past, and referring to their products in the bid announcement.

Instead, gathering the information requires firsthand information obtained through industry contacts, technical consultants, vendor-supplied materials, attendance at equipment and system demonstrations, and visits to existing equipment installations.

This information-gathering usually begins with a check of industry references of other users of similar equipment to review their purchases and to determine whether there are any horror tales associated with that user's selected vendor. This reference check activity may narrow the field of suppliers.

Feeling bolder, the purchaser may telephone or send a facsimile message to request written literature from vendors that are familiar from advertising, equipment displays and demonstrations, as well as vendors referred to him.

Request for proposals

- ☐ **Used to purchase complete systems.**
- ☐ **Defines functions and services.**
- ☐ **May require 'high-technology' procurements.**
- ☐ **Asks vendors for detailed information.**

For purchases involving significant sums of money, the purchaser may want to visit an equipment installation of similar size and cost.

Request for bid specs

Finally, armed with the accumulation of technical information that is consistent with the user's needs and requirements and staying within available funding, RFB specifications must be developed. This document normally is used to purchase hardware items that serve in a stand-alone capacity or as part of an existing, operational network. The bid specifications provide technically specific details for each component within the hardware equipment item defined.

The specification limits listed in the document must account for detailed differences among different manufacturers' products so the purchaser may receive compliant bids from several vendors. This objective requires that the specification-developer maintain current information on product changes of the several leading manufacturers, and be aware of product offerings of manufacturers to avoid.

An RFB normally is used for competitive procurements permitting the purchaser to add defined, developed equipment to an existing system, unless the purchaser has performed system integration engineering himself and is prepared to integrate the equipment that is to be bid into a working system.

In these circumstances, the vendor's role is limited to that of a hardware-provider that will deliver the equipment in boxes with a specified number of technical manuals and an invoice. The purchaser then assumes the responsibility for the integrated system performance and the effective system utilization timetable.

The purchaser undertaking this task must have or obtain the technical capabilities to integrate any newly purchased equipment that is firmware- or software-controlled; that requires connection to other system items or external locations; or a combination.

Because of these constraints, the RFB procedure normally is used for the limited purchase of equipment and not for implementing an elaborate system design or for attempting to purchase equipment hardware to upgrade older technology or to change existing limited-performance capabilities.

Bid statements

In addition to the technical requirements that are specified, the RFBs usually state:

(1) the bid opening date.

(2) the bid submittal location.

(3) the purchaser's bidding and payment terms.

(4) any requirements for submitting bonds.

(5) a representative of the purchaser who can answer questions during the bid preparation.

The bid document usually requires product literature for the specific model bid, the bid price with any "all-award" or other discount offering, the delivery conditions and the vendor's payment terms—if they are allowed, and if they differ from those in the RFB.

In most cases, the RFB process disallows any bidders to take exception to the stated conditions in the bid specifications. Any exception taken may be cause for rejection. Vendors should inquire at the purchasing department whether an exception is necessary to respond to the request. If it is, the vendor should file for written, prior approval. Otherwise, the vendor should provide a fully compliant bid and offer exceptions as alternatives, clearly stating the alternatives' technical or cost benefits.

Request for proposals

With the RFB process, a specific item and quantity of purchased hardware are required to perform a common service. These items usually are furnished as single, self-contained units that have limited need to connect directly with other devices. The purchaser probably does not care if the item is green or tan, or if it is 45.5 inches tall or 48 inches tall, as long as it performs the specified function.

But when the procurement involves a technology-based system such as an information processing and management system, a telephone or telecommunications system, or a full-featured radio system, the purchaser must completely define its requirements in terms suitable to the application.

Because of the vastly differing approaches taken by manufacturers, each with its unique design philosophy, terminology and configurations, no single procurement document can list the specific technical details used by all manufacturers' designs and still permit open and competitive procurement. The design of these systems includes interfaces and processes that may be unique to the vendor's approach, but that still suit the purchaser's overall functional needs.

System procurements

Procurements for complete systems usually are based upon the published request for proposal (RFP), which identifies the functions, features, type, quality and performance of the system being procured. The vendor must propose a complete system that provides in the most efficient and cost-effective manner

those functions and services identified within the RFP. Some procurement ordinances allow RFPs only for "high-technology" procurements. Others allow RFPs in an effort to be less restrictive than an RFB, which, by statute, may not allow any exceptions or latitude on bidder's part.

The RFP should include detailed information regarding instructions to proposers, required proposal data, submittal costing forms, general conditions, special conditions, required insurance forms, vendor information questionnaire, supplemental attachments and a technical description section with attachments.

The major difference between the RFP and RFB specifications is the level of technical specification. Basically, the RFB identifies the equipment to be procured in exact technical details, whereas the RFP defines the job or function to be accomplished by the procured equipment.

Requests for bids vs. request for proposals

- ☐ **RFB identifies the equipment to be procured in exact technical details.**
- ☐ **RFP defines the job or function to be accomplished by the procured equipment.**

Detailed specifications of functional requirements usually are included in the list to ensure suitable good quality of the identified system components.

The instructions-to-proposers section of the RFP should define those items, documents and milestones that are significant to the proposed submittal. It should specify the due date, the proposal submittal location, the preparation method, submittal method, required signatures and number of copies to be submitted. The payment schedule and all required proposal guarantee bonds, as well as all performance and payment bonds, should be stated in this section.

Vendors should be aware that, although the RFP process allows vendors more latitude than an RFB, they may not have complete freedom in their offerings. Some specifications may be quite rigid, and vendors may be disqualified for assuming too much freedom to propose. The best policy is to determine in advance whether certain proposal exceptions or alternatives are acceptable.

Request for information

In cases where buyers are not completely familiar with the latest equipment and services available from all suppliers, the procurement process can begin with a request for information (RFI).

The initial document released by the buyer can state the organization's basic nature, its function as related to the intended procurement and the basic functions of the system it intends to procure.

From the information received in response to the RFI, an RFP or RFB can be developed. But some organizations

Request for information

- ☐ **Used when buyers are not completely familiar with the latest equipment and services available from all suppliers.**
- ☐ **Using information received in response to the RFI, an RFP or RFB can be developed.**
- ☐ **Some organizations may enter directly into contract negotiations for the equipment and services as required and defined in both the RFI and vendor responses. Depending upon the responses to the RFI, the result may justify sole-source procurement, minimizing the chance of protest.**
- ☐ **Usually does not include technical specifications.**

have the ability to enter directly into contract negotiations for the equipment and services as required and defined in both the RFI and vendor responses. Depending upon the responses to the RFI, sole-source procurement could be justified, minimizing the chance of protest.

The RFI usually does not include any technical specifications concerning the equipment to be procured. Rather, it describes the agency, the nature of the agency's job, the general type of system the agency intends to obtain and any functional requirements necessary for the suppliers to determine the proper solution. More often, the process results in the subsequent development of a detailed RFP or RFB. Informed buyer decisions on possible solutions available from potential suppliers can be discovered by the RFI.

High-technology procurements

► *Under traditional procurement acts*—The most profound problem buyers and suppliers experience is the procurement of "high-technology" systems where traditional competitive bidding is required and the contract must be offered to the lowest-cost compliant vendor. The main problem is two-fold.

First is the development of a procurement specification that allows all suppliers the latitude to offer configurations of their own equipment, which normally are the most cost-effective.

Second is the decision of the vendor to offer the least-cost approach or to offer the most cost-effective approach.

If the vendor has an indication that only cost will determine the winner regardless of how cost-effective the offered solution is, the vendor most likely will not offer the cost-effective solution. Only if the potential profit makes the effort worthwhile will the vendor offer the cost-effective solution—and then as an optional or alternative offering.

The true bid process places several constraints upon high-technology procurements that might not be in the

buyer's best interest. Under the RFB process, technical specifications usually require a specific solution to the problem or a specific configuration. This approach may not be conducive to one or several suppliers and the application of their equipment.

Under these constraints, suppliers may not respond to the invitation because of the cost of preparing their responses, the necessity of taking exception to bid specifications and the low chance of their exceptions being accepted.

Moreover, suppliers may not want to provide a response that identifies fallacies in the specifications. Or, they do not wish to complain about the lack of a fair opportunity to propose an optimum configuration with their equipment. Either way, they do not reply.

► *Under high-technology procurement plans*—Many government entities now have the ability to procure high-technology systems and equipment under a true proposal procurement. These "high-technology procurement" acts allow buyers to state the functional requirements and to describe their existing facilities, and allow the suppliers to offer the most cost-effective solution, taking into account the full capabilities of their companies and products.

Under these new procurement ordinances, cost usually is stated as a percentage of the evaluation criteria, instead of being the sole criterion. In this manner, a supplier offering a cheap, yet non-optimal solution will not have any advantage over another supplier offering an optimal solution at a higher cost.

Several constraints that must be definitively addressed in the RFP have been placed on these high-technology procurements. Generally, the RFP must include information describing the proposal evaluation procedures and basis of award—i.e., it must specify the particulars the agency will use during the evaluation.

These particulars may include a point assignment for several discrete categories evaluated. These categories should be listed, and a description of each category should be provided.

Usually, the relative importance of cost and other evaluation factors must be stated in the RFP and must be followed implicitly in the evaluation process.

Another advantage of high-technology procurement plans includes the ability to discuss the proposed approach and to make modifications to the offering in the contract with the selected vendor.

This capability increases the chance that the ultimate system implemented will be the best available, based upon the buyer's ability to educate the supplier concerning the problem and the ability of the supplier to educate the buyer concerning the capabilities of the equipment and configuration options.

All potential suppliers' proposals must be given equal opportunity. All suppliers must be able to discuss the relative merits of their offerings and to provide modifications to their offerings to conform to the buyer's needs and wants.

High-technology procurements

Traditional procurement acts:

- **Usually, the lowest-cost compliant vendor must be offered the contract, which discourages vendors from offering the most cost-effective solutions.**
- **The ordinance may not permit the purchaser to allow a supplier to offer the most cost-effective configuration of its own equipment.**
- **Suppliers may not respond to the invitation because of the cost of preparing their responses, the necessity of taking exception to bid specifications and the low chance of their exceptions being accepted.**

Under high-technology procurement plans:

- **Buyers may state functional requirements and available facilities, as well as allow the suppliers to offer the most cost-effective solution.**
- **Cost usually is stated as a percentage of the evaluation criteria, instead of being the sole criterion.**

Vendors should be aware that most procurement codes allow discussions and modifications of proposals prior to the contract award but prohibit inclusion of equipment and services not required by the original RFP or not offered in the original proposal. Therefore, it is incumbent upon the proposer to offer as many options as possible, especially if substantial amounts of money can be saved by obtaining optional equipment that would satisfy the user's functional requirements, even though it may require a compromise of minor technical specifications.

The key word is *optional*. Make sure that the prime offering is fully compliant and that any non-compliant equipment clearly is stated as optional. Explain fully why the option was offered, and explain all necessary functional details concerning the result of procuring the non-compliant equipment.

Optimum procurement process

There is no need to attempt to justify a sole-source procurement or to develop detailed request-for-proposal specifications to procure pencils and paper clips. Similarly, it is unrealistic to procure trunked radio systems and telephone networks with one-page bid specifications. The procurement process selected must be commensurate with the complexity of the problem and potential solutions.

In addition, all procurement options available should be investigated and discussed at each level of the government agency.

In some cases, the ability to use "high-technology" requests for proposals exists legally, but frequently they are not used. As a result, purchasing agents may be reluctant to attempt the high-technology procurement approach and may try to steer the procurement toward the more traditional request-for-bid approach. As a result, the procurement may not produce the desired results or may not provide the optimum, most cost-effective solution—only the lowest cost.

A little investigation and planning prior to starting the procurement cycle may result in large gains in functional capability and maintainability.

Buyers should not be afraid to ask for the procurement methodology necessary to implement the technology level they intend to procure. Suppliers should be informed of the potential customer's functional requirements and should offer several alternative configurations or options.

The best solution in the buyer's mind may be a consolidated network made up of several of a supplier's ideas. Meanwhile, the buyer may reject other of the same supplier's ideas that he dislikes. If your only offering is disliked or is not practical, the customer has no alternative but to look to another supplier.

Evaluation and vendor selection

If an agency selects and justifies the sole-source procurement methodology, it is of prime importance that a thorough search be made for alternative sources of equipment. All statements made in justification must not only be true, but complete. An inadequate industry evaluation, justification or both, although approved, may negate the process at a later date.

By definition, a bid review procedure should be straightforward, with the purchaser proceeding to purchase high-quality, compliant equipment at a low price. But this is not always the case.

After bids are received, normally they are made available to any interested party. This requires the purchaser to make the information available in a professional, accurate manner.

The information normally is made available by the purchasing department in the form of a comparative spread sheet, which is included as part of the purchaser's bid evaluation.

The vendor community then reviews the bid information to obtain the competition's model offerings, pricing and defined discounts, delivery schedules and any possible special conditions.

Selecting the optimum procurement process

- **Select a procurement process commensurate with the complexity of the problem and potential solutions.**
- **Investigate and discuss procurement options at each level of the government agency.**
- **Buyers should not be afraid to ask for the procurement methodology necessary to implement the technology level they intend to procure.**
- **Suppliers should be informed of the potential customer's functional requirements and should offer several alternative configurations or options.**

Each vendor's local sales representative immediately passes this information to the vendors' home offices.

'Bid protest'

During this evaluation by the vendor community, vendors have been known to be willing to share their concerns about a competitor's equipment or bid conditions with the purchasing department. In fact, some companies have a reputation for spending as much or more time critiquing their competitors' bids to the purchaser than the purchaser spent reviewing the bid package.

The next step the vendor's representative may take, in accordance with company policy, is to send correspondence from the local office to local elected officials and the press. A final step may include making a presentation to the elected governing body that oversees the government agency making the purchase.

During this "bid protest," some interested "friends of the community" (usually friends or associates of elected officials or vendors) may submit their concerns as an expression of civic responsibility.

Meanwhile, the purchaser must focus on the procurement's original intent and must not become intimidated by actions some vendors may threaten. Vendor representatives who make threats and who attempt to intimidate purchasers can do a disservice to their companies.

Government agencies can be part of close-knit networks that regularly pass along information about vendor threats and intimidation. Future procurements by unrelated agencies may eliminate some vendors as a result of their representatives' actions in other locales.

Scoring procedure

If the RFP process is used, the most important aspect of the process is to follow the evaluation and selection procedures exactly as stated in the procurement specification. Any variances surely will lead to a protest.

If a point evaluation is to be used, develop the scoring procedure and score sheets prior to receiving the proposals. This method will result in fewer complaints that the scoring was patterned against or in favor of a particular vendor.

If information or clarifications are necessary from any qualified vendors,

Evaluation and vendor selection

- ☐ **Sole-source procurement requires a thorough search for alternative equipment sources.**
- ☐ **Bid reviews should be straightforward, with the purchaser proceeding to purchase high-quality, compliant equipment at a low price.**

Bid protests

Some companies have a reputation for carrying out bid protests if a competitor is selected as the supplier.

- ☐ **Critiques are given to purchaser.**
- ☐ **Correspondence is sent to local elected officials and the press.**
- ☐ **A presentation is made to the elected governing body that oversees the government agency making the purchase.**

it is a good idea to have discussions with all vendors. These discussions can be accomplished by inviting all vendors to make a presentation on their proposals and system designs.

Any questions either can be answered during the presentation or in follow-up questions afterward. In this manner, all vendors are given a fair and equal opportunity for access to the decision process.

Unless one proposal is accepted without changes, all vendors must be given an opportunity to offer changes to their proposals consistent with the scope of the procurement code.

In most cases, if one vendor is afforded the opportunity to change its proposal to conform, the other vendors should be afforded the same opportunity, even though the non-conforming issues differ.

If the scope of the changes required of a particular vendor exceed the extent of the changes allowed in the procurement code, the vendor should be notified and should not be invited to make a presentation or to hold discussions with the purchasing agency.

In some cases, it is proper to hold a debriefing session with all vendors or with the losing vendors to advise them of their proposals' status. The debriefing session can be the avenue to handle questions concerning competent proposals and to announce the rejection of inadequate proposals.

Be sure to advise the rejected vendors that their proposals did not follow the procedures outlined in the RFP or that their exceptions were not acceptable to the purchaser, if that is the case.

Vendors should not expect an award if their proposals do not follow procedures stated in the RFP or if they take exceptions contrary to the procurement codes.

Contract negotiations

Sometimes it may be preferable to receive the governing body's approval of the vendor selection process and to make the award subject to successful contract development, rather than initially submitting a negotiated contract to the governing body for approval.

Making sure the purchaser has complete concurrence prior to lengthy contract negotiations can save significant time. With concurrence, the governing body's action is to approve the award and to authorize contract negotiations.

With this approach, all protests should be submitted and settled when the award is made, instead of when the contract is approved. After the award is made, the negotiated contract can be submitted for approval.

To protect the interests of the purchaser and the supplier, any procurement should be considered a contract between the parties and should be treated with proper respect. If the procurement is for pencils and paper clips, there is no need for a 50-page contract.

Conversely, a computer-aided dispatch system should not be procured using a purchase order prepared by either party. The contract documents should be prepared by the purchaser, with the vendor's aid and concurrence, and should include:

(1) the terms and conditions of procurement as specified in the RFP.

(2) a statement of work defining both parties responsibilities.

(3) a system technical description, including the system, its components and its functional characteristics.

(4) the acceptance and testing criteria.

(5) supplemental agreements and requirements.

Order of precedence

Both parties to the contract must realize that any issue not covered by the contract documents is governed by all procurement documents in a specified order of precedence. This order of precedence should be stated in the contract terms and conditions.

It is recommended that the RFP or

Scoring proposals

- ☐ **Follow the evaluation and selection procedures exactly as stated in the procurement specification. Variances lead to protests.**
- ☐ **Develop the scoring procedure and score sheets prior to receiving the proposals.**
- ☐ **Invite *all* vendors to discussions involving *any* vendor.**
- ☐ **Unless one proposal is accepted without changes, all vendors must be given an opportunity to offer changes to their proposals consistent with the scope of the procurement code.**

RFB be stated in the contract as a higher order of precedence than the vendor proposal. This mandates that the vendor and purchaser address all issues included in the proposal that differ from the procurement specification in the supplemental agreement portion of the contract.

Therefore, any offers included in the vendor proposal that are accepted by the purchaser should be stated in the supplemental agreement. This step offers additional purchaser protection should the proposer offer an item contrary to the procurement specifications without advising the purchaser—if the purchaser fails to notice the discrepancy.

In this manner, the proposer must identify the issue during contract development and must reach a written agreement. Otherwise, the purchase specifications requirements will govern and not the proposal.

This type of issue usually is not apparent until the system is well on its way to implementation. By the time the purchaser notices the discrepancy, it is much too late to correct the problem economically. The proper order of precedence, as recommended here, forces these issues to surface and to be settled during the contract negotiations.

Contract change order

Because the contract is developed jointly by the parties it is intended to protect, it only makes sense to follow the contract explicitly throughout implementation. Every change made to a contract term, condition or technical issue should be documented in a contract change order.

Contract negotiations

- ☐ **Preliminary approval by the governing body may allow all protests to be submitted and settled when the award is made, instead of when the contract is approved.**
- ☐ **After the award is made, the negotiated contract can be submitted for approval.**
- ☐ **The contract documents should be prepared by the purchaser, with the vendor's aid and concurrence, and should include:**
  1. **the terms and conditions of procurement as specified in the RFP.**
  2. **a statement of work defining both parties responsibilities.**
  3. **a system technical description, including the system, its components and its functional characteristics.**
  4. **the acceptance and testing criteria.**
  5. **supplemental agreements and requirements.**
- ☐ **The contract should state that the RFP or RFB has a higher order of precedence than the vendor proposal.**
- ☐ **Every change made to a contract term, condition or technical issue should be documented in a contract change order.**

Contract change orders that do not affect the contract price normally do not cause problems, though they force both parties to consider the issues adequately.

Contract change orders cause the change to be carried out, along with requiring documentation for future reference and requiring the effect the change has on other aspects of the contract to be explained.

This legal "paper trail" has saved many procurements from disaster. Evaluating options thoroughly and planning in advance always are wise choices.

Understanding the major procurement methodologies helps purchasers and vendors who participate in government procurements. Procurement codes and statutes differ from state to state and city to city. It is impossible to cover all conceivable conditions. If you find a methodology is foreign to you, yet it is necessary for future procurements, check with your procurement office to learn the approved procurement codes.

Classified

Advertising rates in **Mobile Radio Technology's** Classified Section are $64.00 per column inch, per insertion, with frequency discounts available. There is a one inch minimum.

Ads larger than one inch are sized in ¼-inch increments and billed accordingly, as determined by total size of the ad, including ruled borders and rounded up to the nearest ¼ inch.

Blind box ads (replies sent to **MRT** for forwarding) are $30.00 and Fast Fact reader service numbers are available for $25.00 per service, per insertion, to cover processing and handling costs.

Optional color, determined by **MRT** on an issue-by-issue basis, is available at $150 per insertion.

A prepayment discount of 5% is available for all 6x or larger frequency classified advertisers who prepay their full 12 month schedule.

No agency discounts are allowed for classified advertising.

Contact Carla Gamino at (303) 762-1249 in Denver to place your classified ad, or send your classified advertising materials and order to **Mobile Radio Technology,** Advertising Department, P.O. Box 12901, Overland Park, KS 66212.

Professional Directory

Towers, Shelter
Portable Equipment Buildings
Site Construction
General Construction

Tower Structures, Inc.
1869 Nirvana Avenue
Chula Vista, California 92011
Tel (619) 421-1181
Fax (619) 421-0533

OMNICOM, Inc.
COMMUNICATIONS ENGINEERING

GENE A. BUZZI
PRESIDENT

930 THOMASVILLE ROAD, SUITE 200
TALLAHASSEE, FLORIDA 32303
PHONE: (904) 224-4451
BRANCH OFFICES: CHICAGO • SAN DIEGO

OMNISOFT INC

PUBLIC SAFETY COMPUTER SYSTEMS
CAD • MDT • MIS

LAWRENCE R. DANELLO
VICE PRESIDENT

930 THOMASVILLE ROAD, SUITE 202
TALLAHASSEE, FLORIDA 32303
PHONE: (904) 224-5029

MOTOROLA Communications Sales

MOTOROLA Radius Authorized Dealer

Radio Lab Communications

R.F. GALINDO
Manager
Authorized Motorola Service

810 So. Central Avenue
Glendale, California 91204
(818) 246-1605
Fax: (818) 247-3953

LARIMORE ASSOCIATES
EXPERTS IN PUBLIC SAFETY SOFTWARE SINCE 1970

Headquarters
Chesterfield, MO
(314) 537-3112

New England
Cambridge, MA
(617) 497-2958

*Interactive Police, Fire/EMS and Jail Management systems

*Affordable, Customized Software available on multiplatforms for any size department

*Proven reliability, hands-on training and full system support

Equipment for sale

RELM Plus

45 CHANNEL, 60 WATTS, VHF, BUILT-IN SCAN, ALPHANUMERIC DISPLAY, PRIORITY CTCSS AND DCS

RMV60B $569.00 *

* PRICES INCLUDE PROGRAMING
OTHER MODELS AVAILABLE

RSP 500

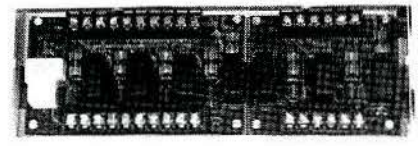
20 CHANNEL, 1 OR 5 WATT SWITCHABLE, VHF, BUILT-IN SCAN, CTCSS, DCS, REVERSABLE, DISPLAY AND WALL CHARGER

$439.00 *

MULTICOM
Sales & Service
1-800-880-RELM (7356)

Central Communications, Inc.

AUXILIARY RELAY PANEL
For Public Safety Mobile Installations



- Saves three hours plus on initial installations; more on re-installations
- Eliminates under-hood mounting of relays
- More reliable than separate relays
- Simplifies Maintenance
- On board fusing
- On board surge and spike protection

For use with Motorola, G.E. and other low current switchpanels in Public Safety Vehicles. Consolidates up to 8 relays onto a printed circuit board in one compact housing. Beacons, amber, flashing and alley lights plus trunk release, gun rack release and other items may be controlled.

REPRESENTED BY
INTEGRATED COMMUNICATIONS
(509) 452-7836 • Dealer pricing available.

Circle (30) on Fast Fact Card

Equipment wanted

WHY PAY MORE!

ATTENTION APCO BUYERS

SAVE THIS AD

Air Comm wants to be your low cost source for:

Motorola "Radius" 2-Way radios

Put us on your bidders list. Call/fax us for same day delivery. We stock what you sell — *quality*.

AIR COMM
4614 E. McDowell
Phoenix, AZ 85008
Tel. (602) 275-4505
Fax. (602) 275-4555

P.S. We sell used/reconditioned mobiles, portables, base stations, any accessory items, including paging and CTS reeds and active filters.

SAVE THIS AD

Circle (31) on Fast Fact Card

Use
Mobile
Radio
Technology
Classified
Ads

Accessories

QUALITY BEEPER COVERS & ACCESSORIES

Covers designed by master-craftsmen with soft quality leather carefully prepared by tanning.

LARGEST selection • *UNIQUELY* designed

- Fully enclosed leather cases with hidden coin pouch
- Leather, Vinyl & Denim slip-on
- ***Introducing Charm & Chain and Neck Chain. Now available, company logo on Charm or Clip!***

call: **ALL GREY ENTERPRISING**
718-946-4636
1-800-542-7485
"We Have You Covered"

Equipment for sale

Equipment Wanted
Motorola, Johnson, GE, EFJ, Uniden, Standard
Buy-Comm-Co.
1-800-347-4121
FAX (602) 395-1357

Your ad could be HERE
for just $64
Call or fax:
Carla Gamino
(303) 762-1249
FAX: (303) 762-0069

Computer software

Antenna Farm
11500 W. 90th St., Overland Park, KS 66214
913-492-6212 FAX 913-492-2948
Cable • Connectors • Antennas
Installation Equipment

ANDREW · DECIBEL · ASTRON CORPORATION · CENTURION · BIRD · MAXRAD · RE · Selectone

LOW PRICES **1-800-255-6222** FAST DELIVERY

PAGER & TWO WAY RADIO LABELS
UNIFORM EMBLEMS
Any quanity welcomed
we do ARTWORK - NO CHARGE
call or send for FREE SAMPLES
ADVANCE LABEL & TAG
1725 N. McDONALD ST.
McKINNEY, TEXAS 75069
1-800-777-9794 214-542-5345

Do you have missing pieces in your coverage?

CDS Real World Propagation™ maps are based on the most accurate propagation model available. Our coverage predictions use proprietary land use/land cover attenuation data derived from extensive field strength measurements, in combination with proprietary enhancements to the NTIA "Longley-Rice" model. *The accuracy of CDS coverage predictions is unmatched—let us show you!*

CDS also offers a variety of online services, FAA and FCC data files, PC programs, and 3 second terrain data on CD-ROM.

Call us today to establish your free online account, or to receive additional information about our services.

Communications Data Services, Inc.

Richard L. and Richard P. Biby, Prinicipals
6105-E Arlington Blvd. • Falls Church, VA 22044
(703) 534-0034 • (800) 441-0034

Circle (32) on Fast Fact Card

Ad index/hotline

Air Comm	31	31 ....602/275-4505
Cadex Electronics, Inc.	24	17 ....604/522-8046
Communications Data Services	31	32 ....800/441-0034
COMPUQUEST, Inc.	18	13 ....800/722-2353
CPI Communications, Inc.	16	11 .....800/869-9128
CTI, Inc.	27	20 ....601/287-8081
Electrocom Automation	IBC	2 .....817/695-5016
Gamber-Johnson	19	15 ....715/344-3482
Integrated Communications	30	30 ....509/452-7836
Kaval Electronics, Inc.	15	10 .....416/940-1400
Kenwood U.S.A. Corporation	IFC	1 .....213/639-4200
Kenwood U.S.A. Corporation	Belly Band	.....213/639-4200
Kustom Signals	25	19 ....800/458-7866
Magnasync	5	6 .....213/962-0382
Mobile Mark, Inc.	23	16 ....800/648-2800
New Eagle Communications, Inc.	16	12 ....913/582-5823
Racal Recorders, Inc.	7,12-13	7,9 ....800/847-1226
SFA Inc.	24	18 ....301/925-9400
Setcom Corp.	11	8 .....415/965-8020
Skaggs Telecomms Service, Inc.	BC	3 .....801/261-4400
Spectracom Corp.	18	14 .....716/381-4827
Teletec Corp.	1	4 .....919/556-7800
Trident Micro Systems	29	22 ....800/798-7881
TWR Lighting, Inc.	27	21 .....713/973-6904
Zetron, Inc.	3	5 .....206/820-6363

Advertising Sales Offices

Publisher
Mercy Contreras
First National Bank Building
333 W. Hampden, Suite 803
Englewood, CO 80110
Telephone: 303-762-1249
Telefax: 303-762-0069

Northeast Region
Ruth Breashears, Marketing Manager
First National Bank Building
333 W. Hampden, Suite 803
Englewood, CO 80110
Telephone: 303-762-1249
Telefax: 303-762-0069

Western Region:
Dennis Hegg, Marketing Manager
950 N. Gate Drive, Suite 207
San Rafael, CA 94903
Telephone: 415-491-1442
Telefax: 415-491-1842

Southern Region
Diane Hite, Marketing Manager
First National Bank Building
333 W. Hampden, Suite 803
Englewood, CO 80110
Telephone: 303-762-1249
Telefax: 303-762-0069

Midwest Region
Nancy Matthews, Marketing Manager
55 East Jackson Blvd., Suite 1100W
Chicago, IL 60604
Telephone: 312-435-2340
Telefax: 312-922-1408

EUROPE:
Nicholas McGeachin
Richard Woolley
Unit 3
Castle Farm Bus. Cntr.
Clifton Road, Deddington
Oxford, OX15 4TP UK
Telephone: 44 (0) 869 38794
Telefax: 44 (0) 869 38040
Telex: 837469 BES G

Classified Sales
Carla Gamino, Classified Marketing Manager
First National Bank Building
333 W. Hampden, Suite 803
Englewood, CO 80110
Telephone: 303-762-1249
Telefax: 303-762-0069

JAPAN:
Mashy Yoshikawa, Marketing Manager
Orient Echo, Inc.
1101 Grand Maison
Shimomiyabi-Cho, 2-18
Shinjuku-ku
Tokyo 162, Japan
Telephone: 33-235-5852
Telefax: 33-235-5961
Telex: J-33376 MYORIENT

Continued from page 19

and benefits soar, new technologies will reduce the time consumed by mundane activities today. Public safety officers will be able to spend more time in problem-solving activities. Direct information entry (with validation and supervisor approval) not only will decrease dissemination delays radically, it will eliminate serial data entry transmission errors and assure higher accuracy. Vast amounts of community-condition information will be captured, analyzed and distributed to the field.

On a large scale, the *community-oriented problem-solving police information system, totally on-line* (COPS-PISTOL) program being designed by Anderson Consulting will bring high levels of information handling to managers and field officers in the Aurora, CO, police department. The system is intended to capture appropriate community conditions and to offer officers a menu of problem-solving options.

On a small scale, software products, such as the New Wave Office from Hewlett-Packard, Cupertino, CA, automatically perform many information managing steps for multiple sources and databases. An experienced executive or systems designer trains the software to perform data searches, inquiries and analysis as the manager concentrates on other activities. Once trained, the software replicates the same routine. The time a person otherwise might spend on routine functions is reduced drastically.

Technology for the '90s

New public safety information technology philosophies can improve police and fire officers' skills and productivity. Automation of mundane and repetitive tasks frees administrators and officers for more personal contact with the community. The third wave of public safety information technology can provide the tools for serving the future.

References

1. Tafoya, Dr. William L., *A Delphi Forecast of the Future of Law Enforcement*, FBI, U.S. Department of Justice, 1986.
2. Toffler, Alvin, *Waves of Change* and an address to an FBI International Symposium on the future of law enforcement.

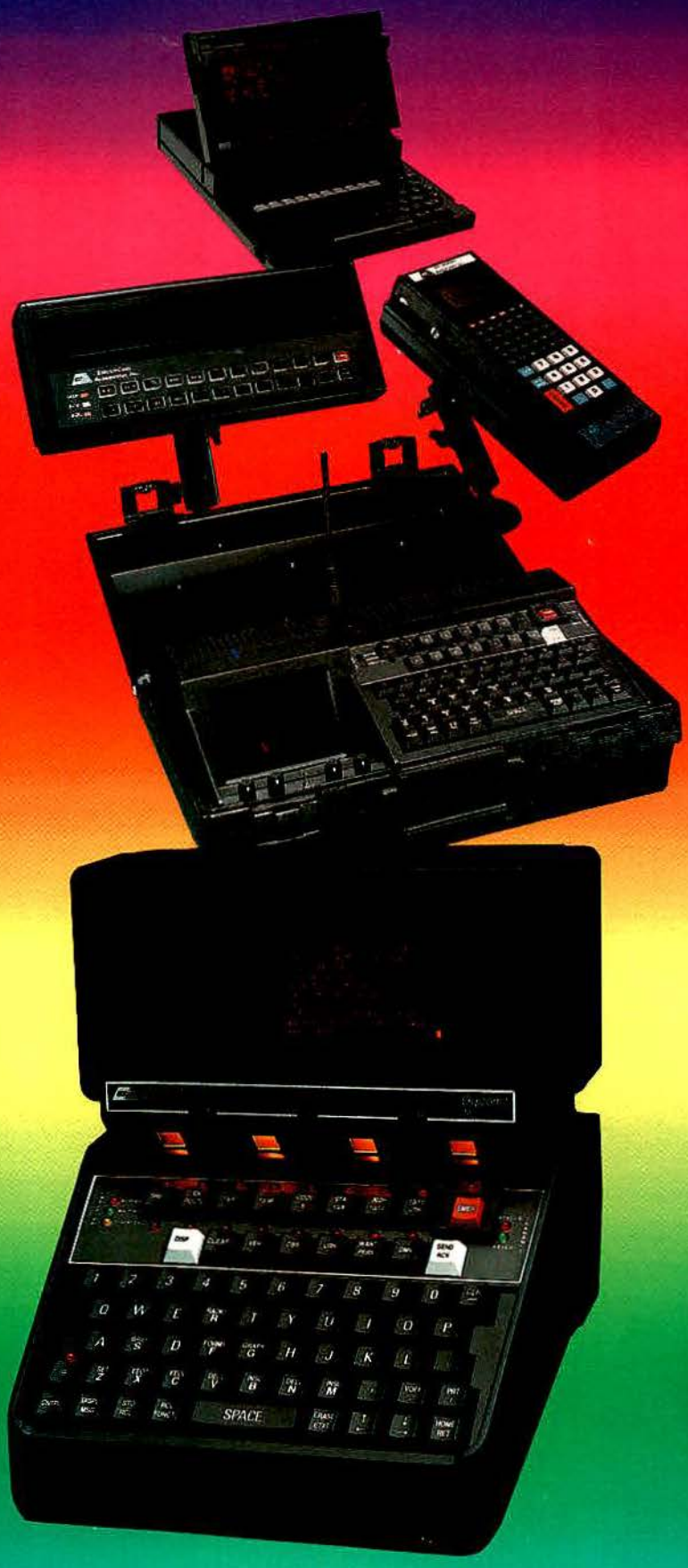
The Value of One Mobile Data System Supplier...

is absolute.

Multiple agencies,
or even one agency,
on a Mobile Data System,
have a variety of
communications needs.

ElectroCom Automation
understands this.
Our family of data products,
spearheaded by the
MDT-870 Mobile Data
Terminal, is designed
to meet those needs, while
assuring you of complete
system compatibility.
Plus you have the added
assurance that Electrocom's
total turnkey expertise
is available.

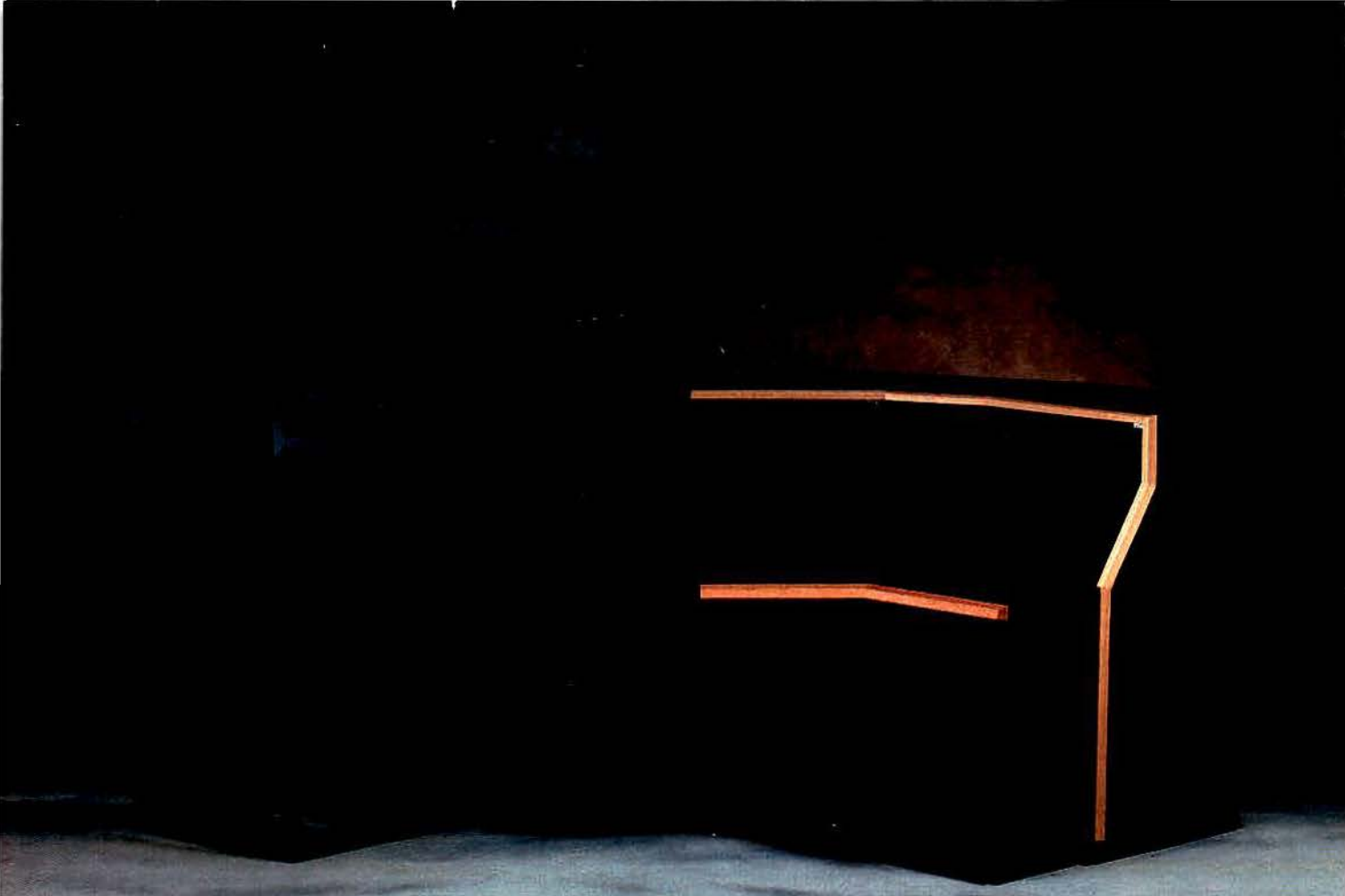
Call or **Write** us for more
information on how
ElectroCom Automation
can help you secure the
data communications
you desire and deserve.



ElectroCom Automation L.P.

P. O. Box 95080 • Arlington, TX 76005-1080 • U.S.A. • Telephone 1-800-433-5175

Circle (2) on Fast Fact Card



Modular Concept. Custom Design.

STS consoles can be custom designed and built for your facility, at about the same prices you'd expect to pay for off-the-shelf furniture.

STS uses advanced fabrication techniques based on modular concepts, combined with master craftsmanship to bring you the best in equipment consoles at highly competitive prices.

Our consoles and racks feature welded tubular steel framework. Welds are carefully finished and the entire frame is protected with tough, baked-on epoxy coating, ensuring that your furniture will keep its good looks through years of service. Choose from a wide range of top-quality laminates and hardwood trims. Color-coordinated counter-tops, correct ergonomics for your application, and the look of custom-built furniture all give your installation the professional appearance you deserve.

From single-bay consoles to elaborate control centers, STS offers you the greatest value in the industry. So, before you make any furniture decisions, come to STS. Call today for more information.

STS

Stoggs Telecommunications Service, Inc.

5200 South Main, Murray, Utah 84107 • P.O. Box 27427, Salt Lake City, Utah 84127 • (801) 261-4400, Fax: (801) 261-1560

Circle (3) on Fast Fact Card